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(72) Inventor: **Tihon, Claude**
Eden Prairie, Minnesota 55347 (US)

(74) Representative:
Charig, Raymond Julian
Eric Potter Clarkson,
Park View House,
58 The Ropewalk
Nottingham NG1 5DD (GB)

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(71) Applicant: **ContiCare Medical, Inc.**
Eden Prairie, MN 55347 (US)

(54) **Self-cleansing bladder drainage device**

(57) An urethral drain having deep external drainage channels, a low-profiled bladder retention segment, and a reversibly detachable collection segment, facilitates the draining of urine and fluids from the bladder. The low-profiled retention means minimizes bladder irritations and the deep external channels reduce the occurrence of infections. Incorporation of a reduced diameter smooth segment on the catheter, proximate the location of the external urethral sphincter allows the patient to void normally and at will. Modifying the size of this smooth segment aids the function of a defective sphincter in controlling urine leakage. The drain can be worn concealed within the urethra. Flushing action from normal voiding washes out particulate matters in the urethra and the concealed drain further minimizes contamination. Together, these features improve quality of life for patients needing catheterization.

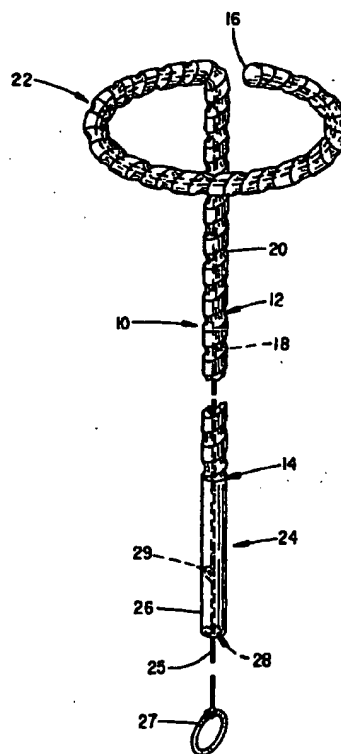


FIG. 1

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Description

BACKGROUND OF THE INVENTION

[0001] I. Cross Reference to Related Application:

[0002] This application is a continuation-in-part of application serial no. 08/960,136, filed October 29, 1997 (now abandoned), which is a continuation-in-part of application serial no. 08/579,592, filed December 26, 1995 (now U.S. Patent 5,738,654), which is a continuation-in-part of application serial no. 08/407,297, filed March 20, 1995 (now U.S. Patent 5,562,622), and entitled "SELF-CLEANSING BLADDER DRAINAGE DEVICE".

[0003] II. Field of the Invention: This invention relates generally to body fluid drainage devices, and more particularly to a urinary drain having improved performance characteristics.

[0004] III. Discussion of the Prior Art: Urethral catheters, such as the Foley catheter, now used for bladder drainage are essentially elongated tubular structures placed in the urethra for draining urine through the central lumen thereof. Near the distal end of the tube is an inflatable balloon which, when inflated while in the bladder, allows the catheter to be held in place. Its proximal end has a drainage port as well as a balloon inflation port. The proximal end of the catheter protrudes beyond the urethral orifice and can be attached to a bag receptacle for the collection of the near constantly dripping urine from the bladder. The collection bag is either attached to the patient's leg when the patient is ambulatory, or to the side of the bed during bed rest. At times, a plug is used in place of the bag to stop the leakage of urine from the catheter tip.

[0005] When Foley catheters or the like are used, patients are not able to void when they want to. Rather, urine is continuously drained from the bladder through the central lumen of the elongated tube and into the collection bag. Ambulatory patients are therefore obligated to have the leg bag attached to their leg, and this poses a source of great inconvenience, unsightliness and problems affecting their quality of life. Due to the fact that urine is continuously being drained from the bladder, the bladder is continuously near empty. The dome of the bladder, therefore, rests continuously on the water-filled bulging balloon retention part of the Foley catheter, causing tissue compression, irritation and erosion related adverse side effect problems. Furthermore, increased urinary tract infection is common with patients using such catheters, especially when used on a chronic basis. Though the causal factors have not been precisely identified, length of time of catheterization has been associated with an increased frequency and severity of urinary tract infection, presumably due to the migration of bacteria up the urethral tract. Frequently, yellow encrusted and mucoid proteinaceous depositions containing bacteria are found on the surfaces of the catheter with much higher concentration on the inner lumen surfaces. The mandated usage of urine receptacles causes additional associated stigma of soiled clothing, furniture and odor.

[0006] The Spinoso et al. Patent 3,815,608 discloses in Figure 9 thereof a typical Foley urinary catheter having an inflatable balloon 64 for retaining the distal end portion of the catheter with its drainage hole 56 within the urinary bladder. An alternative embodiment disclosed in Figures 6 and 7 of the Spinoso et al. patent depicts a urinary catheter that uses a helically threaded region thereof as the retention means in place of an inflatable balloon. This device still relies upon the central lumen 46 as the urine path while the channels 48 define between the helical threads 44 allow for "drainage of exudate discharged from the prostate gland".

SUMMARY OF THE INVENTION

[0007] The present invention provides a solution to increase the quality of life for patients who require drainage catheters by solving compression and irritation related problems, giving patients an option to carry on their daily lives more normally

and reduce incidence of the common urinary tract infections. One embodiment of the invention comprises a bladder drainage device having at least one deep, open fluid-drainage channels and a low profile bladder retention means at its distal end. In addition, it can contain an essentially smooth segment, preferably narrowed, in the area of the external urethral sphincter. Urine drains from the bladder, via the open surface channels. The narrowed smooth segment permits the external urethral sphincter to function normally to shut off the leakage of urine from the bladder to the lower portion of the urethra. The drainage channels may but need not reappear below the external sphincter. When the sphincter opens, urine and fluid will flow past the relaxed sphincter area at the smooth, narrowed drain region, and down between the narrowed region and the urethral wall. Unlike the situation with the Foley type catheter and the catheter of Figures 6 and 7 of the Spinoso et al. '608 patent, where urine is continuously drained in a leaking fashion from the bladder through an internal lumen of the drainage catheter, the present configuration of the invention allows urine to be stored in the bladder until voided in mass, much as in a normal manner, when the patient is ready to do so. Due to this natural and daily multiple automatic flushing action in the urethra and channel walls by a rushing of the bolus of urine, the bladder drain of the present invention is self-cleansing without any added external pressurized flushing equipment means, such as that described in U.S. Patent No. 4,723,946, or any added steps for the patient.

[0008] The device of the present invention, without the smooth segment, can be worn by patients in cases where constant urine drainage is required or unavoidable. Thus, the drain will have the benefits of the lower profile retention means for reduced bladder irritability, and the deep external drainage channel(s) causing urine flow to be in contact with the urethral wall to minimize colonization of bacteria and other contaminants within a lumen, thus lower possibility of infections.

[0009] The presence of the narrow, smooth segment at the site of the external urethral sphincter region allows

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the natural constriction of the external urethral sphincter to terminate the flow of fluid to the distal bulbous and penile urethra as the sphincter normally functions. The patient is, therefore, able to control his own voiding frequency. This permits the drain device to be worn by ambulatory patients without the necessity of an external urine drainage collection leg bag.

5 [0010] Patients suffering from urinary incontinence have differing degrees of contractibility of the external urinary sphincter, depending upon age and other factors. By providing a smooth surface section that can be repositioned along the length of the externally grooved drain member and which can be selected for its outer diameter, a variety of patients can be accommodated.

10 [0011] The distal end of the drain device located within the bladder contains a retention means for retaining it at the bladder neck. This preferably a coiled section of the flexible, deep open channeled drainage device, which is initially straightened for insertion in the urethra by a straightening stylet placed in a central lumen of the drain device. Removing the wire after drain placement restores the curl. Due to the fact that the low profile retention means is an extension of the drainage segment, no balloon is needed, nor is there a necessity for a perpendicular, upward-protruding tubing with lateral openings for the passage of urine. The retention means is spaced apart from the smooth narrowed section a distance to assure drainage within the prostatic urethra. Before exiting the urethra, the deep channels are replaced by a traditional tubular structure, the collection segment, which proceeds to exit the urethra. This collection segment collects fluid from the narrowed drain body or from the deep external channel(s) above, transports it beyond the meatus of the penis, and permits the attachment of a urine drainage collection bag or a plug at the proximal end. The tubular collection segment can be readily detached from the main drain body, thus leaving the entire drain device concealed inside the urethra. This further insures minimal infection from outside contamination, and avoids the aesthetically displeasing and uncomfortable presence of an external device.

20 [0012] Given the anatomical differences between the urinary systems in males and females, and in particular the short length and shape configuration of the female urethra, the drainage device for a female patient preferably comprises a soft, flexible, plastic body member having a flat coil bladder retention means at its distal end and a corresponding retention means at its proximal end to prevent the device from migrating upward into the bladder. The proximal retention device is configured to conform to the vestibule proximate the urethral opening. It is preferably an open structure or perforated to permit exposure of the underlying tissue to air.

25 [0013] In addressing female stress incontinence, a cuff member of a chosen size appropriate for the patient may be placed about the drain member to cooperate with the urinary sphincter, allowing the sphincter to create an improved seal against the cuff to block urine flow.

[0014] Thus, the object of this invention is to greatly increase the quality of life for patients who require bladder drainage catheters.

30 BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The foregoing features and advantages of the invention will become apparent to those skilled in the art from the following detailed description of the present invention, in which numerals in the several view refer to corresponding parts.

35 Figure 1 is an elevational view of a bladder drain in accordance with a first embodiment of the invention;

Figure 1(a) is a partial view of the bladder drain of Figure 1, but with an alternative anchoring structure;

Figure 2 is an elevational view of an alternative embodiment of the bladder drain in accordance with the invention;

40 Figure 3 is a view illustrating the embodiment of Figure 2 inserted in the male urethra;

Figure 4 is a fragmentary, enlarged perspective view of the portion of a bladder drain, illustrating two straight surface grooves;

45 Figure 5 is a fragmentary, enlarged perspective view of a portion of a bladder drain illustrating spiral surface grooves;

Figure 6 is an enlarged cross-sectional view of a portion of the body of a bladder drain having four surface grooves extending the length thereof;

50 Figure 7 is an enlarged cross-sectional view through a portion of the body of a bladder drain having three surface grooves extending along the length dimension thereof;

Figure 8 is an enlarged cross-sectional view through a portion of the body of a bladder drain having a positionable smooth sleeve segment affixed thereto;

55 Figure 9 is a partially sectional, fragmentary view of the embodiment of Figures 1 or 2 proximate the junction between the grooved bladder drain element and its associated collection segment;

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Figure 9(a) is an exploded, partial, sectional view of a drain member having straight (non-spiral) surface grooves and a collection tube used therewith;

Figure 10 is an enlarged, partial, perspective view of a segment of the drain of Figure 7 and incorporating retention rings thereon;

Figure 11 is a partial side elevation of a drain device having the configuration of Figure 7 and illustrating an alternative drain retention feature.

Figure 12 illustrates an alternative embodiment of the invention for placement in the female urethra;

Figure 12(a) shows a variation of the embodiment of Figure 12;

Figure 13 illustrates the device of Figure 12 but with an alternatively configured proximal retention means;

Figure 14 illustrates the device of Figures 12 or 13 with a cuff member placed thereon when treating female stress incontinence;

Figures 15A, B and C illustrate alternative shapes for the cuff member illustrated in Figure 12;

Figure 16 illustrates an alternative preferred embodiment of a bladder drain in accordance with the invention;

Figure 17 shows the bladder drain of Figure 16 as it is packaged for use by a medical professional;

Figure 18 shows the drain of Figure 17 with its straightener deployed;

Figure 19 illustrates the straightener of Figure 18 removed from the drain and collection tube;

Figure 20 shows an alternative tether for the bladder drain device;

Figure 21 shows a further embodiment of a urethral drain having an enlarged drain segment for cooperating with the prostate;

Figure 22 is a greatly enlarged view of the anti-migration device used with the bladder drain of Figure 16;

Figure 23 shows the configuration of an alternative anti-migration device;

Figure 24 is a perspective view of an alternative preferred embodiment of a bladder drain in accordance with the invention and incorporating an alternative bladder retention structure;

Figure 25 is a top view of the bladder drain of Figure 24;

Figure 26 is yet another alternative embodiment of the present invention;

Figure 27 is a top plan view of the device of Figure 26;

Figure 28 is a side elevational view of an embodiment that is a variation of that shown in Figure 21;

Figure 29 is a cross-sectional view taken along the line 29-29 in Figure 28; and

Figure 30 is still a further preferred embodiment of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0016] Referring first to Figure 1, there is shown a perspective view of a bladder drainage device in accordance with a first embodiment of the invention. It is indicated generally by numeral 10 and is seen to comprise an elongated, flexible tubular member 12 having a proximal end 14 and a distal end 16 and with a stylet receiving lumen 18 extending longitudinally toward but just short of the distal end 16. Thus, the distal end 16 covers the stylet lumen precluding the flow of body fluids therethrough when the drainage device 10 of the present invention is in place within the urethra of a patient.

[0017] With continued reference to Figure 1, the body member 12 of the drainage device 10 is shown as including at least one channel 20 formed in the surface thereof and it extends substantially the entire distance from the proximal end 14 to the distal end 16. In Figure 1, the channel 20 is shown as spirally traversing the drain body 12, but it is to be understood that the channel or channels may be straight, as well. With no limitation intended, for a

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drain device having an outside dimension of 0.21 inches, the helical channel 20 may have a depth of approximately 0.06 inches. The body member is preferably fabricated from a flexible polymer material, such as silicone, silastic, polyurethane or another thermoplastic elastomer having a durometer shore hardness between about 30 and 95 shore A.

5 [0018] Disposed proximate the distal end of the bladder drain device is a bladder retention segment 22 which comprises a curled end portion which can be straightened by the full insertion of a wire stylet (not shown) through the lumen 18. However, when the stylet is fully withdrawn following insertion of the drain assembly as shown in Figure 1 into the urethra with the distal portion within the bladder, the memory property of the plastic comprising the distal end portion of the drainage device 10 allows the preformed distal end, bladder-retaining portion 22, to form a loop or curl as illustrated. Those skilled in the art can appreciate that means other than a controlled memory property are available for creating the curl on the distal end of the drainage device. For example, a short wire segment having a preformed shaped can be embedded into the body of the drain to enhance the formation of the curl upon extraction of the stylet.

10 [0019] Attached to the proximal end of the bladder drain 10 is a fluid collection segment, indicated generally by numeral 24. The fluid collection segment 24 may be attached and detached from the drainage segment 12 in a manner that will be described later herein. In its simplest form, the collection segment 24 comprises an elongated plastic tube having an internal lumen extending from the proximal end 14 of the drain segment 10 to an open distal end 28 which forms the drain outlet. The collection segment 24 can accept a drainage bag or a plug not shown.

15 [0020] To facilitate removal of the drain, a strand such as a monofilament nylon line 25, is fixedly secured to the proximal end 14 of the drain 12 and extends beyond the proximal end 28 of the collection segment 24 and out the urethral opening in the penis. By grasping the monofilament line 25 by the loop 27 and pulling on the line, the memory property of the fixation member 22 is overcome and the drain can be readily pulled through the urethra and out the end of the penis. If desired, the line 25 may terminate short of the proximal end 28 of the collection segment 24 and in that event, an instrument having a hook on it may be passed up the lumen of the collection segment 24 to grasp a loop 29 tied in the line. By now pulling on the instrument, the drain member 12 can again be removed.

20 [0021] An alternative embodiment of the invention is depicted in Figure 2. The assembly of Figure 2 is similar in most respects to the embodiment of Figure 1 except that in the drain device 30 of Figure 2, the tubular member 12 includes a narrowed and smooth (non-channeled) segment 32 for cooperating with the external sphincter of the urethra. At the distal end of the segment 32 is a tapered shoulder 36 and at the proximal end is a more squared shoulder 36. The length of segment 32 is preferably in the range of from 0.5 cm to 5.0 cm and its outer diameter may be from 0.1 to 2.0 cm.

25 [0022] Referring next to Figure 3, it shows the bladder drain device 30 of the embodiment of Figure 2 disposed in the male urethra. The bladder retention portion 22 is located proximate the neck of the bladder 35 and with the installation stylet (not shown) fully removed, the bladder retention portion assumes its flat spiral configuration, thereby holding the drainage device in place. The portion of the drainage device 30 located above the tapered shoulder 34 is dimensioned to traverse the prostate 36 and with the zone 32 of reduced diameter extending through the external urethral sphincter 38. If desired, a string or monofilament 25 can be co-extruded with the drain device of Figure 2 to inhibit stretching of the device in zone 32 when tensile forces are applied during removal of the drain.

30 [0023] The spiral curl 22 comprising the retention element is essentially perpendicular to the axial length of the drain and does not protrude appreciably above the base of the bladder. This low, flat profile distinguishes the present invention from the common Foley catheter, which is retained by means of a liquid filled balloon, as well as from the device shown in U.S. Patent No. 4,738,667 to Galloway. The removal of a straightening stylet, as compared to the removal of an outer shield in the Galloway device, serves to minimize any irritation to the urethral wall of the patient. The use of an internal straightening wire, as contrasted to a design utilizing an external straightening sleeve, also allows the existence of deeper drainage channels for a given outer diameter of the drain itself. While the bladder retention segment is depicted as a spiral or curl at the distal end of the body member 12 comprising the drain, it can be appreciated that an inflatable balloon adhered to the exterior of the tubular body 12 and communicating through a port bridged by the balloon leading to an inflation lumen may be employed to anchor the drain in a fashion similar to what is conventionally used with a Foley catheter. Such an arrangement is shown in Figure 1(a), with the silastic balloon identified by numeral 39.

35 [0024] With the embodiment of Figure 2 in place, as illustrated in Figure 3, there will be a continuous flow of urine from the bladder 35 through the channel 20 formed in the exterior wall of the drain segment 30 with the channel emptying into the lumen of the urine collection tube 24. For patients having a functioning external urethral sphincter 38, the compressional force on the urethra in the zone 32 of the drain will close the urethra against that segment thereby blocking urine flow. When the patient desires to drain his or her bladder, he or she voluntarily relaxes the external urethral sphincter 38, allowing the contents of the bladder 35 to flow through the channel(s) formed in the wall surface of the drainage device 30 to again empty into the urine collection tube 24 leading to a collection bag (not shown).

40 [0025] Figures 4 through 7 are included to show alternative ways of configuring the drainage segments 10 and 30 illustrated in Figures 1 and 2, respectively. In Figure 4, the drainage segment 12 includes two straight longitudinal channels 40 and 42, diametrically opposed from one another, that extend substantially the entire length of the drainage segment. Also visible in Figures 4 through 7 is the stylet lumen 18. In the embodiment of Figure 5, the surface grooves, as at 20, form a spiral, as in the embodiments of Figures 1 and 2. This spiral pattern may conveniently be formed during the fabrication process by twisting the segment 12 during the extrusion process prior to cooling. By controlling the amount of twisting, the pitch of the channels can be controlled.

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[0026] While linear channels of the type shown in Figure 4 may be provided in the drainage segment, a spiral channel configuration is preferred in that the lateral projections on the outer surface of the drain will interact with the urethral wall in such a fashion as to retard movement of the drain along the axial length of the urethra, thus minimizing undesired migration thereof. The side walls of the channels are preferably undercut or dished, as at 44 (Figure 6), to thereby prevent irritation of the urethra, and to inhibit invagination of the urethral wall tissue into the channels.

[0027] Figures 6 and 7, respectively, show cross-sectional views of the drain in which four and three channels, respectively, extend the length thereof.

[0028] Referring to the cross-sectional view of Figure 8, another way of forming a smooth segment along the length of the drainage member 12 for cooperating with the external urinary sphincter of a given patient is to provide a short length of tubing, as at 45, having an internal lumen whose side walls are complimentary in shape to the exterior surface of the grooved drainage member 12. Thus, the smooth portion of the tube 45 can be longitudinally adjusted to a location along the drain body where the urinary sphincter is located for that patient. Also, the outside diameter of the removable and replaceable smooth tubular segment 45 can be selected to accommodate the particular contractibility of the urinary sphincter of the patient to provide increased continence and will usually be in the range of from 0.3 cm to 1.0 cm.

[0029] It is further contemplated that the smooth tubular member 45 on the female urethral drain can comprise an inflatable sleeve surrounding the drain member 12 (Fig. 1). This is deemed to be beneficial in cases of female stress incontinence in that the sleeve can be inflated after placement to a degree effective to preclude leakage between the expandable sleeve and the neck of the bladder and to compensate for sphincter deficiency.

[0030] Referring now to Figure 9, there is shown an enlarged fragmentary, partially sectioned view of the bladder drain showing the manner in which the fluid collection tube 24 is joined to the proximal end of the grooved drainage member 12. The proximal end 14 of the drainage member 12 is provided with a narrowed neck 46 which is followed by an expanded end portion 48. The fluid collection tube 26 has a complimentary profile 50 adapted to snap over the end portion 48 to occupy the narrowed neck 46. Urine passing along the channels 20 between the internal wall of the urethra and the drain is channeled into the lumen of the collection tube 26 to flow out its proximal end 28, either continuously when the embodiment of Figure 1 is employed or in a controlled manner when the embodiment of Figures 2 or 8 is utilized. Detachment of the flexible plastic collection tube 26 may be accomplished by pulling on the tube 26 in the proximal direction while simultaneously employing a stabilizing push rod 52 to hold the drainage segment 12 in place. After detachment of the collection tube 26, the drain device is entirely contained within the urethral tract.

[0031] Figure 9(a) is an enlarged, exploded, partial sectional view of a drain member 12 having straight (non-spiral) grooves such as is illustrated in Figure 7 of the drawings and illustrating an alternative arrangement for connecting the drain body to an associated collection tube. The drain body 12 is molded or extruded so as to have a plurality of straight parallel grooves as best seen in Figure 7. Surrounding the proximal end portion of the drain 12 is a ring member 53 which is secured to the exterior of the lobes of the drain body separated from one another by adjacent grooves. To better concentrate and direct the urine stream, the central portion of the drain body is cored out, leaving only the lobes depending in a zone of a predetermined length distal of the ring 53. The collection tube 24 includes an internal annular groove 55 into which the ring 53 on the drain body is adapted to be inserted. As such, the portion of the lobes on the drain body that are free from the central or core portion thereof fall within the lumen 57 of the collection tube and thereby directing the urine stream flowing down the longitudinal grooves in the drain body to flow into the lumen 57 of the collection tube.

[0032] To enhance the ability of the urine to find its way into the central lumen of the collection tube, it may be expedient to include a pattern of holes as at 59 through the wall of the collection tube where the size of the holes 59 are made slightly larger toward the distal end of the collection tube 24 and of a smaller size as at 61 at locations more proximal than the larger holes 51.

[0033] As those skilled in the art will appreciate from the foregoing description of the embodiment of Figure 9, the same technique for detaching the plastic collection tube 26 from the drainage device 12 can be utilized with the embodiment of Figure 9(a).

[0034] To assist in preventing migration of the drain devices having linear channels as in Figures 4 through 7, a series of longitudinally spaced rings as at 54 in Figure 10 may be placed about the drain body 12 at predetermined intervals. The rings are preferably relatively flat and are appropriately bonded to the drain body 12. It is found that the tissue of the inner wall of the urethra invaginates the channels 40, 42 on opposite sides of the rings 54, inhibiting longitudinal displacement of the drain assembly. With no limitation intended, the rings 54 may be approximately 2 mm wide and 1 mm thick. Further, they may be placed approximately 1 cm apart from one another along the length of the drain body 12 on one or both sides of any smooth segment of reduced diameter as at 32 in Figure 2 that is intended to cooperate with the urinary sphincter. By providing rings 54 along the length of the drain device, it is no longer necessary to include a central stylet receiving lumen 18. The stylet, instead, can be routed up one of the surface channels 40 and 42 and will be constrained by the rings.

[0035] Figure 11 shows an alternative anchoring arrangement to that shown in Figure 10. Instead of incorporating spaced-apart rings extending about the drain body, small, laterally projecting tines 56 that are located proximate the junction between the drain body 12 and the collection tube 24. The tines 56 are intended to engage the interior wall of the urethra to prevent migration of the drain assembly in the distal direction toward the urinary bladder. When it is desired to remove the drain, a force applied to the strand 25 (Figure 1) will cause the tines 56 to deflect or collapse into alignment with the wall of the tubular body 12 and offer practically no drag or resistance

against movement in the proximal direction. While the tines 56 are shown as being formed by cutting or slicing into the elastomeric material comprising the drain body 12, such tines can alternatively be provided on the collection tube 24'. Furthermore, rather than providing tines as at 56 in Figure 11, the retention means can take the form of a bulbous protrusion (not shown) formed on the lobes of the drain body 12.

[0036] Figures 12, 12(a), 13 and 14 show the configuration of alternative devices insertable into the female urethra for addressing stress incontinence. It is seen to comprise an elongated, flexible, plastic rod which, in the instant embodiments, is free from surface channels throughout its length. Preformed at its upper end is a retention segment 60 which is intended for placement within the urinary bladder. Such placement is enhanced by inserting a suitable stylet through an aperture 62 for temporarily straightening the curl of the retention segment 60 and allowing its insertion into the urethral opening. When the device 58 has been advanced sufficiently far up the urethra such that the segment of the device forming the retention member 60 resides in the urinary bladder, upon removal of the stylet, the memory property of the plastic material comprising the device 58 allows the retention member to reform into a flat spiral shape as illustrated.

[0037] To prevent the upward migration of the device as it is being worn, it is also provided with a proximal retention segment 64 which, in Figure 12, also comprises a flat ring-like segment that lies in a plane that is at a predetermined angle to the body portion 66 and that is dimensioned to abut the vestibule and underlie the labia minora. As such, the device may remain within the patient while still allowing normal sexual activity to take place.

[0038] Instead of forming the proximal end portion of the drain member 66 into a flat spiral such as is shown at 60 in Figure 12, to create a retention member, it is also contemplated that a separate closed ring as at 64 positioned about the drain body and secured to it by connecting spokes made from a suitable soft plastic be used. This is the configuration illustrated in Figure 12.

[0039] It has been found expedient to preform the device 58 so that the elongated straight segment 66 extends downward below the lower retention member 64 as indicated by numeral 68 in Figure 12. Urine flow tends to follow the straight portion 66 due to surface tension effects and provides a proper urine stream leaving the urethra. In some patients, the projecting portion may cause irritation and become a source of discomfort. The proximal end 68 of the drain member 66 may also be located above the plane of the ring-like lower retention segment 64 and, therefore, remain fully within the urethra, but close to the meatus. The segment 64, however, remains in the vestibule covering areas anterior, lateral and posterior to the meatus.

[0040] The embodiment of Figure 13 is like that of Figures 12 and 12(a) except that the proximal retention ring 64 is replaced by a highly flexible oval-shaped sheet of plastic 70 that is permeable to the flow of air, due to the fenestrated nature of the plastic material shown as a having a pattern of closely spaced openings, as at 72, extending through the thickness dimension thereof. Again, the air pervious retention member disk 70 is sized and shaped to conform to the area of the body closely surrounding the urethral opening in the vestibule. The proximal end of the body member 66 extends below the retention member 70 and is supported by webs, as at 73, extending across a larger circular opening formed in the sheet 70 which permits urine to flow in a stream as it exits the device.

[0041] In the embodiment of Figure 13, measures are taken to decrease the weight of the retention member 60. Here, the curl portion only is made tubular and is fenestrated by a plurality of openings 61 extending through the wall of the curl to the lumen thereof. This minimizes trauma to the bladder.

[0042] Referring next to Figure 14, the incontinence control device 58 may include an appropriately sized cuff member 74 placed on and affixed to the straight shaft portion 66 of the device of Figures 12 and 13 at a location that will conform to the shape of the urethra proximate the woman's urinary sphincter. A urologist, fitting the woman with the device, will determine the appropriate size and shape of the cuff member 74 that will cooperate with the sphincter muscle to provide an effective seal when the sphincter is contracted. The cuff 74 may include a longitudinal bore sized so that the plastic rod 66 comprising the device and its retention member 60 can pass through that bore. Alternatively, the cuff member 74 may be provided with a fine slit extending through a side wall surface thereof to a central bore, allowing it to be assembled onto the device 58 by first spreading the cuff member and fitting it over the straight segment 66. Releasing the cuff member allows it to close about the shaft 66.

[0043] Figures 15A, B and C illustrate alternative shapes for the cuff member 74 from which the urologist may choose in deciding which provides the best seal with the urethra when the urinary sphincter is contracted. The cuff of Figure 15A is generally cylindrical but has conically tapered opposed ends to facilitate its being inserted and removed from the urethra along with the device 58. Figure 15B is somewhat bone-shaped where the sphincter cooperates primarily with the narrowed zone between the two larger opposed end portions. The cuff of Figure 15C has multiple annular narrowed regions which can assist deficient sphincter muscles to better coapt the urethral wall to the cuff during a sudden increase in bladder pressure occasioned by laughter, coughing or sneezing.

ALTERNATIVE EMBODIMENT

[0044] Referring to Figure 16, there is indicated generally by numeral 76 a urinary drain comprising an alternative embodiment to the present invention. It is seen to comprise an elongated, flexible tubular body member 78 having a proximal end 80 and a distal end 82 with a stylet receiving lumen (not shown) extending from the proximal end 80 toward but just short of the distal end 82. Thus, the distal end 82 covers the stylet lumen, precluding the flow of body fluids therethrough when the drainage device 76 is appropriately placed within the urinary tract of the patient.

[0045] The body member 78 of the drainage device 76 is shown as including at least one channel 84 formed in the surface thereof and it extends from the distal end 82 to a zone 86 where the outside diameter of the drain body

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member 78 tapers to a lesser diameter where the drain body is void of any surface groove. As with the embodiment of Figure 1, the drain body member 78 may have an outside dimension of about 0.21 inches in the portion distal of the tapered zone 86 and the channel 84 formed in this portion may have a depth of approximately 0.06 inches. Again, the body member 78 is preferably fabricated from a flexible polymer material, such as silicone, silastic, polyurethane or another thermoplastic elastomer having a durometer between about 30 and 95 Shore A.

5 [0046] Affixed to the drain body member 78 at a location that is a predetermined distance proximal of the tapered zone 86 is an anti-migration cage 88. This cage, shown in enlarged form in Figure 20 is designed to cooperate with the internal wall of the urethra at a location proximal of the patient's urinary sphincter to prevent distal migration of the drain body within the urinary tract of the patient in whom it is placed.

10 [0047] Disposed at the distal end of the bladder drain device 76 is a bladder retention segment 90 in the form of a curled distal end portion which is adapted to be straightened at the time of insertion into a patient by the advancement of a stylet device within the aforementioned stylet receiving lumen. The details of this process will be considered in greater detail below with the aid of Figures 17-19.

[0048] Affixed to the proximal end 80 of the drain body 78 is an elongated string or thread 92. The string or thread 92 may be of a length sufficient to extend from its connection point at the distal end 80 of the drain body or beneath the cage 88 out and beyond the urethral meatus.

15 [0049] Figure 17 illustrates the flexible, self-cleaning urethral drain and its associated deployment device and stiffening stylet as it is packaged by the manufacturer prior to use. The drain 78 has the thread or string 92 extending through a central lumen of a pusher member 94 and a clip 96 is secured by a knot in the string 92 such that when the thread 92 is taut, the clip 96 engages the molded plastic hub 98 affixed to the proximal end of the pusher 94. With the anti-migration knob 88 being of a larger diameter than the diameter of the central lumen of the pusher 94, the anti-migration knob 88 will be held in place against the distal end of the pusher 94. The molded hub 20 98 on the proximal end of the pusher member 94 allows it to be readily gripped during use.

[0050] Referring momentarily to Figure 19, the stiffening stylet 99 used with the alternative embodiment is seen to comprise a fine semi-rigid wire 100 whose overall length is sufficient to extend through the tubular drain body 78 when the hub/handle 102 affixed to the proximal end of the wire 100 is made to abut the proximal end of the hub 98 of the pusher member 94. Surrounding the wire 100 and extending toward the proximal end 80 of the drain body 25 when contained within the collection tube 94 is a plastic tubular sheath 104.

[0051] Referring again to Figure 17, when in the package prior to use, the stiffener or stylet 99 of Figure 19 is partially retracted with its hub 102 spaced a distance back proximally from the proximal end of the molded plastic hub 98 on the pusher member. As such, the wire 100 does not extend into the curled portion 90, so that the curl forms at the distal end of the drain body. The stiffening device 99 of Figure 19 is partially retracted during shipping and storage so that plastic deformation does not result in a permanent loss of the ability of the drain 30 member to revert to a curl in the bladder following insertion of the drain into the patient's urethra after the stiffening member 99 is removed.

[0052] In Figure 18, the stiffening member of Figure 19 is shown as being fully advanced so that the hub 102 thereof abuts the molded plastic hub 98 on the proximal end of the pusher 94. With the stiffening device 99 fully inserted, the wire 100 is effective to straighten the curl 90 such that the distal end 82 of the drain device can 35 more readily be inserted into the patient's urethra. Once the distal end portion of the drain body has been advanced into the urinary bladder and the stiffening device completely withdrawn, the memory property of the plastic comprising the drain body will result in the return of the curl formation on the drain body to provide bladder retention.

[0053] The insertion procedure takes place by grasping the hub 98 on the pusher member 94 while simultaneously advancing the stylet 99 until the stylet wire advances through the stylet lumen of the drain body 78 to the point 40 where the distal curl is straightened. The clip 96 abutting the hub 98 prevents separation of the drain body from the pusher. The distal tip of the drain body is then positioned at the meatus and advanced through the urethra by simultaneously advancing both the stylet 99 and the pusher member 94 through the urethra until the distal end portion of the drain body is positioned in the bladder. While continuing to grip the hub 98 of the pusher member to prevent movement of the drain body in the proximal direction, the stylet 99 is pulled free of the assembly, allowing the distal end portion of the drain body to reassume its curled condition for retaining the drain body in the bladder and urethra. Next, the clip 96 can be removed from the string or tether 92 allowing the pusher member 94 to 45 be stripped free of the drain.

[0054] When it is desired to remove the drain device, the string 92 may be tensioned resulting in the curl 90 being drawn through the bladder neck and straightened as it is pulled down through the urethra.

50 [0055] The foregoing description of the removal of the drain removal procedure contemplates that the string or tether 92 will extend out through the meatus. With some patients, the presence of the string hanging from the end of the penis may not be acceptable. Figure 20 illustrates a way in which the tether may be configured so that upon insertion of the drain into the patient's urethra, the portion extending beyond the meatus may be readily removed. In the arrangement of Figure 20, instead of having a single strand 92 connected to the proximal end portion 80 of the drain body, a small closed loop of string 95 comprising a first separable segment is secured to the drain body and longer loop segment 97 engages the loop 95 and extends out beyond the distal end of the hub 98. Once the drain is inserted into the urethra in the manner described above, when the clip 96 is removed from the strands, the pusher 55 94 can be stripped out of the urethra and by cutting the loop 97, it can be pulled free of the loop 95, with loop 95 remaining totally within the urethra. A thin wire stylet having an atraumatic hook-shaped tip may be inserted through the meatus and up the urethra to engage the loop 95 when it is drained that the drain be withdrawn from the body.

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[0056] In the embodiments of Figures 1 and 2 and Figures 16-20, the bladder retention curl 22,90 is shown as being of the same diameter as the portion of the drain body that cooperates with the male prostate gland. It has been experimentally determined that for a given Shore A hardness, e.g., 70, a bladder retention portion diameter of 17 Fr is about the maximum size that a patient can tolerate easily. Larger diameter bladder retention segments create too high of a bladder retention strength, resulting in discomfort when the catheters are being removed. There are incidences, however, where additional urine flow is desired through the portion of the urethra subtended by the prostate. The urinary drain configuration shown in Figure 21 is designed to allow such increased urine flow past the prostate gland. In this arrangement, the bladder retention curl 90' is designed to be of a lesser diameter than the portion 78' that is designed to span the prostate gland. Thus, for example, the bladder retention portion 90' may have a diameter of about 16 Fr while the portion 78' may have a diameter of about 24 Fr, allowing for deeper grooves 79' for urine to flow through.

[0057] Figure 22 is a greatly enlarged view of the anti-migration cage 88 used with the drain device 76 of Figure 16. It is seen to comprise a flat annular ring 106 that is supported by a plurality of integrally formed ribs 108, 110 and 112 that are arcuately formed and joined to a tubular base 114 to form a cage-like structure. The reduced diameter portion of the drain body 78 proximal to the tapered section 86 fits through a bore 116 formed in the base 114 and is bonded in place at a location that will be proximal of the patient's urinary sphincter when the retention curl is disposed in the urinary bladder and the portion of the drain body distal of the tapered section 86 spans the patient's prostate gland. The flat distal end of the annulus 106 engages the inside wall of the urethra and abuts the closed external sphincter muscle to prevent migration thereof in the distal direction while still permitting urine to flow through the open cage-like structure once voluntary voiding takes place as the patient relaxes his urinary sphincter. Because the arcuate ribs 108, 110 and 112 are deformable and because the tubular base 114 is of a significantly smaller diameter than the annulus 106, removal of the drain from the urethra does not result in damage to the delicate lining thereof as the string 92 is pulled on to displace the drain.

[0058] Figure 23 shows an alternative construction of an anti-migration cage 88' that can be used on the urinary drain of Figure 16. It comprises a tubular body 118 having a central bore 120 for receiving a portion of the drain body therethrough. The anti-migration cage 88' of Figure 21 is also bonded to the drain body at the appropriate location there along. The tubular body 118 includes a plurality of integrally formed, regularly circumferentially-spaced, rounded and tapered lobes 122, 124, 126 and 128. The lobes cooperate with the urethral wall proximal of the urinary sphincter when the drain is in place. The lobes serve to hold the urethral wall in spaced relation to the remainder of the tubular body so as to allow for urine flow therebetween. As with the anti-migration cage 88 of the Figure 21, the tapering shape of the cage 88' of Figure 22 facilitates subsequent removal of the drain from the urethra while the upper edge surface thereof (when viewed as in Figure 22) as well as the radially projecting lobes function to inhibit unwanted movement of the drain device in the distal direction following the insertion thereof into the urinary tract.

[0059] The anti-migration cages 88 and 88' described herein are considered an improvement over prior art balloon anti-migration structures which require complex inflation and deflation mechanisms and which are subject to mechanical failures. More importantly, prior art balloon anti-migration devices occlude the urethra and prevent flow of urine past it. The open structure of the anti-migration cages 88 and 88' described herein do not prevent such urine flow and because they are made of tissue compatible soft plastic material, they do not materially irritate the urethral lining either during placement, removal or during prolonged periods of use.

[0060] Figure 24 comprises a bladder drain like that of the embodiment of Figure 16 but with the retention curl segment 90 thereof replaced with a differing style of retention member. As in the embodiment of Figure 16, the urinary drain of Figure 24 includes a flexible body member 78 having a proximal end 80 and a distal end 82. The body member 78 includes at least one channel 84 formed inwardly of the generally cylindrical surface thereof and it extends from the distal end 82 to a zone 86 where the outside diameter of the drain body member 78 tapers to a lesser diameter where the drain body is void of any surface groove.

[0061] As in the embodiment of Figure 16, there is affixed to the drain body 78 at a location that is a predetermined distance proximal of the tapered zone 86 an antimigration cage 88 as has been previously described.

[0062] Located near the distal end of the bladder drain is a bladder retention member 130 that comprises first and second longitudinally spaced rows of radially-extending, soft, flexible petals that are generally equally circumferentially spaced about the periphery of the drain body 78. The petals in an upper row are angularly spaced and the petals in the row beneath it line up between adjacent petals on the upper row as is best seen in Figure 25.

[0063] The bladder retention member 130 is preferably formed in a molding operation such that the leaves project radially from a central tubular member 132 (Figure 25) such that attachment to the drain body 78 involves fitting the tube 132 over the drain body and bonding the tubular member 132 thereto.

[0064] To facilitate placement of the device of Figure 24 into the urinary bladder, an outer sheath (not shown) may be employed. If a sheath is used, it would be slipped over the drain body 78, compressing the petals of the bladder retention member 130 against the surface of the drain body 78. Once the device has been advanced through the urethra to the point where the retention member 130 would be disposed within the urinary bladder, the outer sheath can be slipped off the drain, allowing the petals to spread and engage the bladder neck so as to resist expulsion of the drain device. Urine flows through the channel 84 as in the embodiment of Figure 16 and the patient's sphincter cooperates with the portion of the tubular body member below the taper 86 to provide voluntary voiding of the bladder.

[0065] The petals comprising the retention member 130 are sufficiently flexible and pliable, however, that the application of tension forces to the tethers will cause the petals to fold up against the drain body as the device

is withdrawn from the urethra.

[0066] The retention device 130 is preferably molded from a suitable plastic with a soft silicone rubber being preferred. The retention member, when unconstrained, may have a diameter of approximately one-half inch and the petals in each row may be spaced at 90 degree intervals.

[0067] In Figure 26 there is identified generally by numeral 134 a urinary drain in accordance with a further embodiment of the present invention. It includes a distal end portion 136 that comprises a soft, flexible plastic cylinder having a closed rounded distal end 138 and at least one and preferably more surface grooves 140 and 142 formed inwardly to provide channel(s) through which urine may flow. At the base of the distal end portion 136 is a retention member 144 like that shown in Figure 24. It includes first and second levels or rows of petals, such as four petals at 90 degree radial spacings. The petals in the upper row are offset 45 degrees from the petals in the lower row. The distal tip portion 136 is bonded to a soft plastic tube 146 having a pattern of apertures 148 arranged in a spiral extending the length thereof. The tubular portion 146 is dimensioned lengthwise to span the prostate gland in a male patient when the distal end portion 136 is resident within the urinary bladder and the retention petals 144 are engaging the bladder neck. Anchored to the lower end 150 of the tubular member 146 by webs 152 is a small diameter soft plastic tube 154 that extends across the urinary sphincter and through the urethra towards its meatus. As in the embodiment of Figures 16 and 24, an anti-migration cage 88 is affixed to the small diameter tube 154 so as to be immediately proximal of the patient's urinary sphincter. This enlargement or cage 88 cooperates with the urinary sphincter to prevent the device from migrating in a distal direction.

[0068] The devices of Figures 24 and 26 are inserted in the same fashion as the drain device of Figure 16 using a pusher member 94.

[0069] Once in place, urine contained in the bladder can flow through the channels 140 and 142 on the distal end portion 136 of the drain following the channels into the lumen of the tubular member 146. The presence of the apertures 148 allows secretions from the prostate gland to be washed away by urine flowing into and out of the apertures as it traverses the prostate. The outside diameter of the small diameter tube 154 spanning the sphincter allows the sphincter to close about the O.D. thereof, allowing voluntary voiding of the bladder. As mentioned, the anti-migration cage 88 is provided to prevent upward displacement of the drain assembly 134 within the urethra while the retention petals 144 inhibit downward or proximal movement of the drain device.

[0070] The flexible, self-cleaning urethral drain illustrated in Figures 28 and 29 comprises a flexible, elongated drain body 78" formed from a soft elastomeric material such as silicone rubber. The exterior surface of the drain body includes at least one and preferably more than one open fluid drainage channel as at 79" extending substantially the entire length thereof. Affixed to the distal end of the drain body 78" is a bladder retention curl which is preferably formed from a relatively small diameter tube that is preshaped such that when unconstrained by having a stiffening stylet inserted therein assumes a somewhat spiral shape with a portion of the retention device 90" extending below the upper rounded distal end 156 of the drain body 78". By thus forming the bladder retention curl 90", it is insured that the channels 79" will be exposed to the interior of the bladder when the retention device 90" is resident in the bladder neck.

[0071] To inhibit invagination of bladder neck tissue into the surface drainage channels 79", it may prove expedient to provide a thin plastic band 158 about the periphery thereof to prevent irritation to bladder neck tissue. Without the band, prostatic tissue may invaginate the surface channels 79" and with normal activity, contact between the drain body and the bladder neck may result in irritation. By providing the band 158, this irritation is minimized or avoided.

[0072] During certain surgical procedures and following radiation treatment for bladder cancer or the like, there is a propensity for tissue particles to sluff off from the bladder wall and these particles can result in blockage of the surface channels 79", preventing effective draining of urine from the bladder. To obviate this problem, a modification may be made as shown in Figure 30. Here, rather than grinding a rounded tip on the drain body 78", the drain body is provided with a flat distal end 160 and affixed to it and at least partially surrounding the upper ends of the surface drainage channels 79" is a pre-formed plastic dome 162 having a series of fine slits 164 formed in it. Urine in the bladder may flow through the slits while particulate matter is blocked from flowing therethrough and into the surface channels 79". Again, the bladder retention device 90" is formed so that a portion thereof is at a level that is below the upper end of the dome 162 whereby the slits 164 reside above the bladder neck when the drain device is inserted through the urethra and properly positioned. A stiffening stylet as at 166 may be passed up through the drain body 78", the dome 162 and into the lumen of the tubular retention device 90" to render the bladder retention device rectilinear during placement of the drain.

[0073] In any of the disclosed embodiments, it may prove efficacious to coat the drain member with hydrogel to render it more soft and lubricious to aid in insertion thereof. The coating may also incorporate a slow-release drug therein to combat urinary infection or to provide treatment to urinary organs.

[0074] This invention has been described herein in considerable detail in order to comply with the Patent Statutes and to provide those skilled in the art with the information needed to apply the novel principles and to construct and use such specialized components as are required. However, it is to be understood that the invention can be carried out by specifically different equipment and devices, and that various modifications, both as to the equipment details and operating procedures, can be accomplished without departing from the scope of the invention itself.

Claims

1. A flexible, self-cleaning urethral drain for draining of urine and fluid from the bladder through the urethra of

a patient, comprising:

- 5 (a) a flexible, elongated drain body having a distal end and a proximal end with an outer diameter allowing passage through the urethra, the drain body having an exterior surface with an open fluid drainage channel on at least a portion of said exterior surface, the drain body cooperating with the wall of the urethra for draining urine between the exterior surface of the drain body and the urethral wall;
- (b) bladder retention means located adjacent to the distal end of the drain body for retaining the drain body in place in the urethra;
- 10 (c) means on the drain body for inhibiting longitudinal migration of said drain body relative to the urethral wall;
- (d) a flexible tether affixed to the proximal end of the drain body of a length allowing the tether to extend out beyond the patient's urinary meatus when the bladder retention means is located in the patient's bladder;
- 15 (e) a tubular member of a diameter that can be inserted into the patient's urethra to the proximal end of the drain body by said tether extending through an internal lumen of the tubular member; and
- (f) a removable clip member attachable to the tether at a point of exit of the tether from the proximal end of the tubular member.
- 20 2. The flexible, self-cleaning urethral drain as in Claim 1 wherein said tether includes first and second separable segments where the length of the first separable segment is such that the first separable segment resides totally within the urethra when the bladder retention means is located in the patient's bladder.
- 25 3. The flexible, self-cleaning urethral drain as in any one of Claim 1 wherein the means on the drain body for inhibiting longitudinal migration comprises a soft, bulbous, hollow cage-like structure having a plurality of arcuate longitudinal ribs supporting an integrally formed annulus on a tubular base, said tubular base surrounding and affixed to a portion of said drain body and cooperating with the urethral wall proximal of the urinary sphincter when said urethral drain is in place in the urethra.
- 30 4. The flexible, self-cleaning urethral drain as in Claim 3 wherein the cage-like structure is positioned on said portion of the drain body with the integrally formed annulus located distal of the tubular base, the annulus having an outer diameter greater than an outer diameter of the tubular base.
- 35 5. The flexible, self-cleaning urethral drain as in any one of Claim 1 wherein the means on the drain body for inhibiting longitudinal migration comprises: a tubular body having a central bore for receiving a portion of the drain body therethrough, the tubular body being bonded to the drain body and including a plurality of integrally formed, regularly circumferentially spaced, rounded and tapered lobes, the lobes cooperating with the urethral wall proximal of the urinary sphincter when said urethral drain is in place in the urethra.
- 40 6. A flexible, self-cleaning urethral drain for draining of urine and fluid from the bladder through the urethra of a patient, comprising:
 - (a) a flexible, elongated drain body having a distal end and a proximal end with an outer diameter allowing passage through the urethra, the drain body having an exterior surface with an open fluid drainage channel on said exterior surface, the drain body cooperating with the wall of the urethra for draining urine between the exterior surface of the drain body and the urethral wall;
 - 45 (b) bladder retention means located adjacent to the distal end of the drain body for retaining the drain body in place in the urethra, said bladder retention means comprising a plurality of circumferentially spaced petal-like projections surrounding an affixed to the drain body; and
 - (c) means on the drain body for inhibiting longitudinal migration of said body relative to the urethral wall.
- 50 7. The flexible, self-cleaning urethral drain as in Claim 6 and further including:
 - (a) a flexible tether affixed to the proximal end of the drain body, the tether being of a length allowing a portion thereof to extend out beyond the patient's urinary meatus when the bladder retention means is located in the patient's bladder.
 - 55
8. The flexible, self-cleaning urethral drain as in Claim 7 wherein said tether includes first and second separable

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segments where the length of the first separable segment is such that the first separable segment resides totally within the urethra when the bladder retention means is located in the patient's bladder.

- 5 9. The flexible, self-cleaning, urethral drain as in Claim 8 wherein said plurality of petal-like projections are grouped into two longitudinally spaced rows, with the petal-like projections in the first of the two rows circumferentially offset from the petal-like projections in the other of the two rows.
- 10 10. The flexible, self-cleaning, urethral drain as in either of Claim 9 wherein the petal-like projections are adapted to fold against the exterior surface of the drain body when being inserted and withdrawn from a patient's urethra.
- 10 11. A flexible, self-cleaning urethral drain for draining of urine from the bladder through the urethra of a patient, comprising:
- 15 (a) a flexible, elongated drain body having a distal end and a proximal end with an outer diameter allowing passage through the urethra, the drain body having an exterior surface for cooperating with the wall of the urethra for draining urine between the exterior surface of the drain body and the urethral wall;
- 20 (b) a bladder retention means comprising a generally smooth closed-ended tube with a stylet receiving lumen and being located adjacent to the distal end of the drain body, the tube being preformed into a predetermined shape when unconstrained by a stylet where a portion of the bladder retention means is at a location disposed between the distal end and the proximal end of the drain body for retaining the drain body in place in the urethra when the bladder retention means is disposed in the patient's bladder; and
- (c) means on the drain body for inhibiting longitudinal migration of said body relative to the urethral wall.
- 25 12. The flexible, self-cleaning, urethral drain as in Claim 11 and further including a thin elastomeric sleeve surrounding a portion of the drain body for preventing invagination of prostatic tissue into the fluid drainage channel.
13. The flexible, self-cleaning, urethral drain as in Claim 11 and further including means affixed to the distal end of the drain body for inhibiting blockage of the open fluid drainage channel by tissue particles.
- 30 14. The flexible, self-cleaning, urethral drain as in Claim 13 wherein the means for inhibiting blockage comprises a hollow dome defined by a generally hemispherical wall affixed to the distal end of the elongated drain body, said dome having slits formed through the hemispherical wall for passage of urine while inhibiting passage of the tissue particles therethrough.
- 35 15. The urethral drain of Claim 11 wherein the means on the drain body for inhibiting longitudinal migration comprises a ring-like member disposed at the proximal end of the drain body for cooperating with the genital vestibule of a female patient.
16. The urethral drain of Claim 15 wherein the proximal end of the drain body is exterior of the meatus when the bladder retention means is located in the patient's urinary bladder.
- 40 17. The urethral drain of Claim 15 wherein the proximal end of the drain body is internal to the urethra when the bladder retention means is located within the patient's urinary bladder.
18. The urethral drain of Claim 11 and further including means for eluting a drug from the exterior surface of the drain body.
- 45 19. The urethral drain of Claim 11 and further including a lubricious coating on the exterior surface of the drain body.
20. The urethral drain of Claim 19 wherein the lubricious coating comprises a hydrogel.
21. The urethral drain of Claim 19 and further including an elutable drug contained in the lubricious coating.

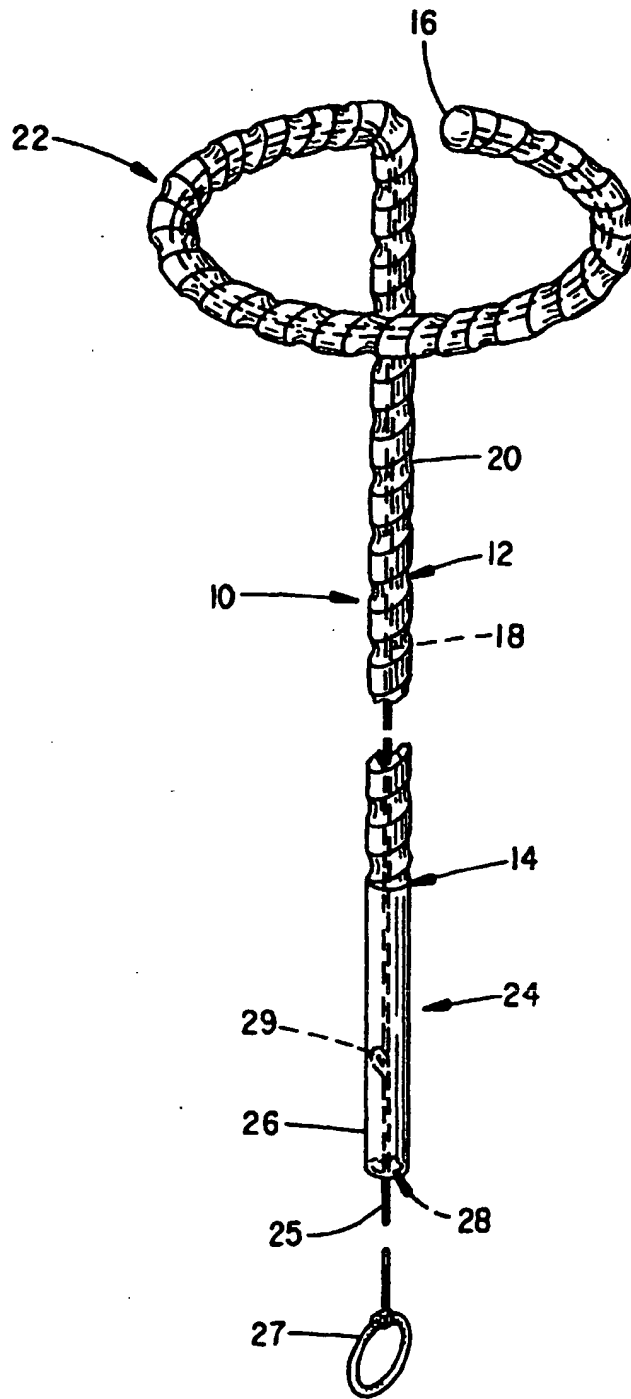


FIG. 1

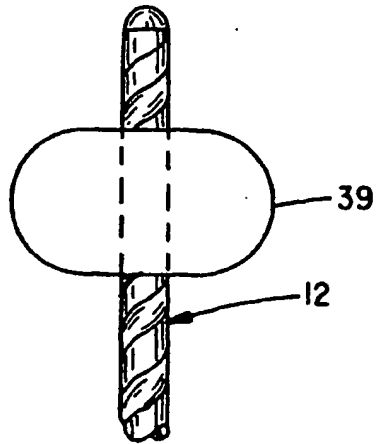


FIG. 1 (a)

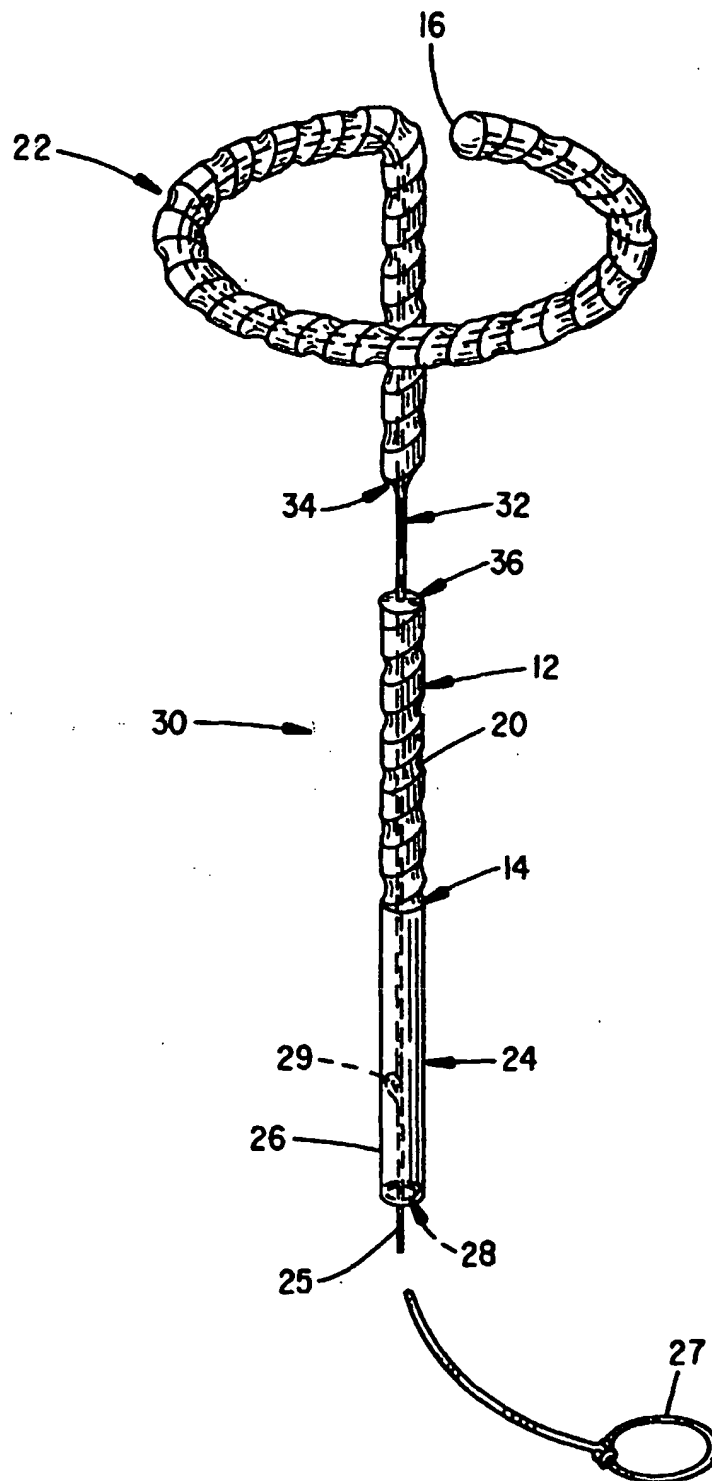


FIG. 2

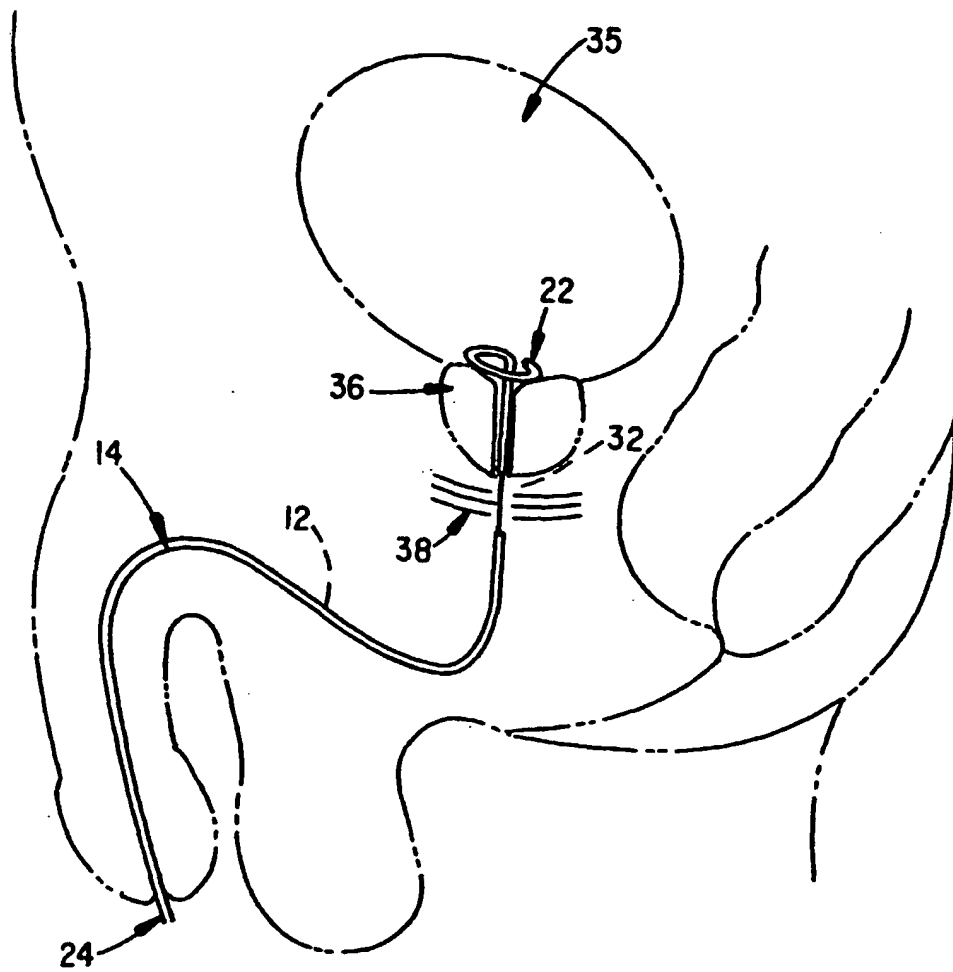


FIG. 3

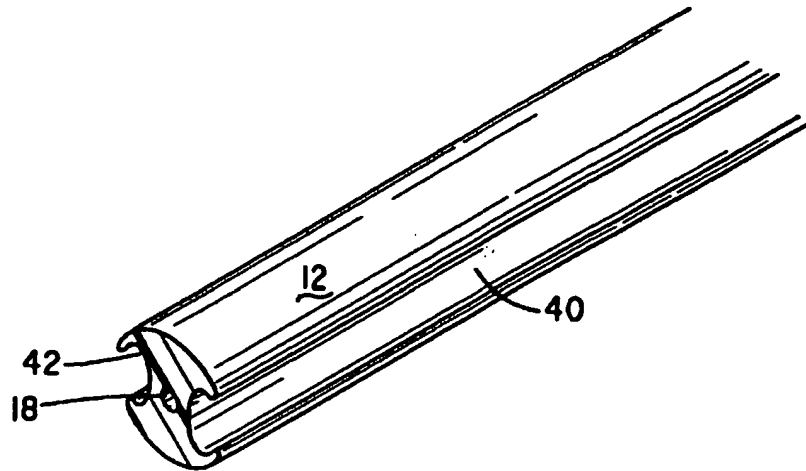


FIG. 4

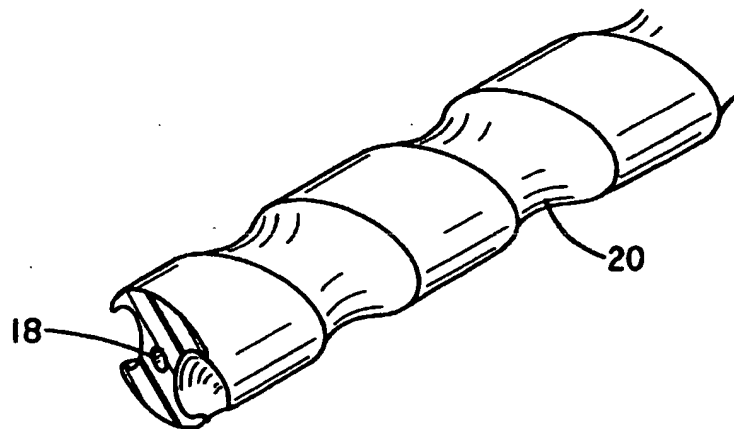


FIG. 5

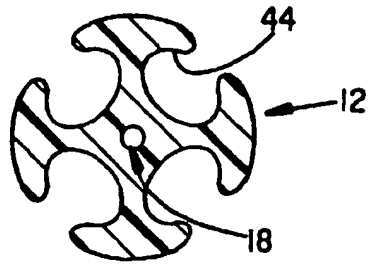


FIG. 6

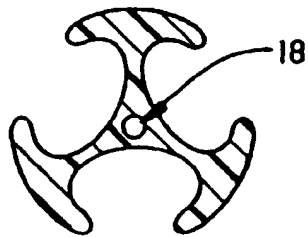


FIG. 7

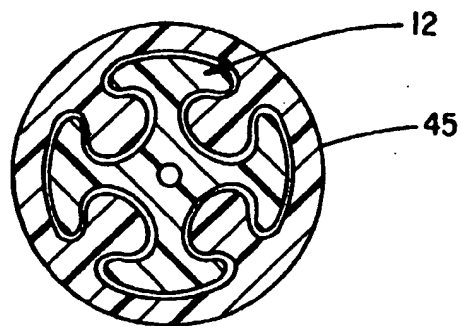


FIG. 8

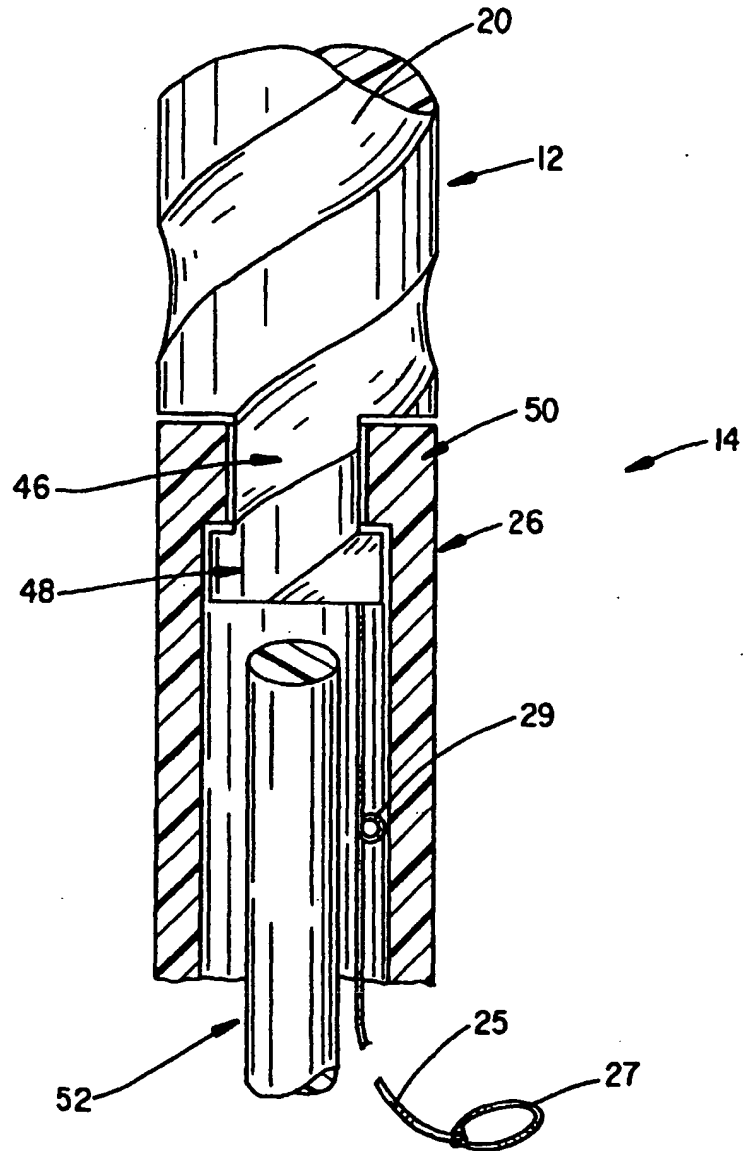


FIG. 9

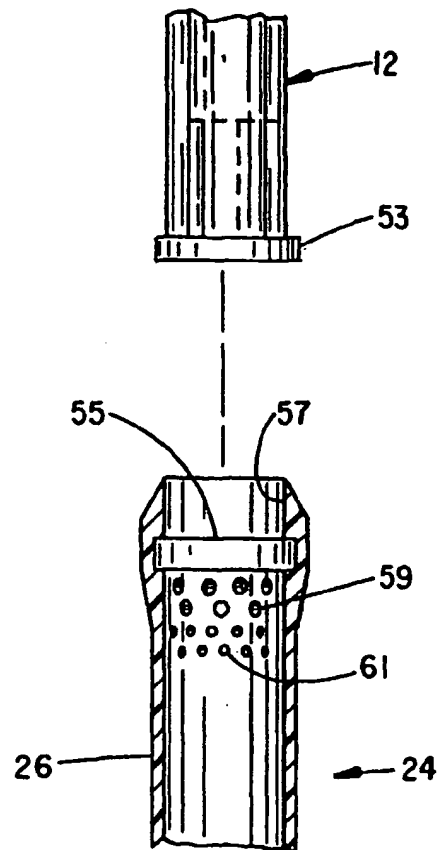


FIG. 9 (a)

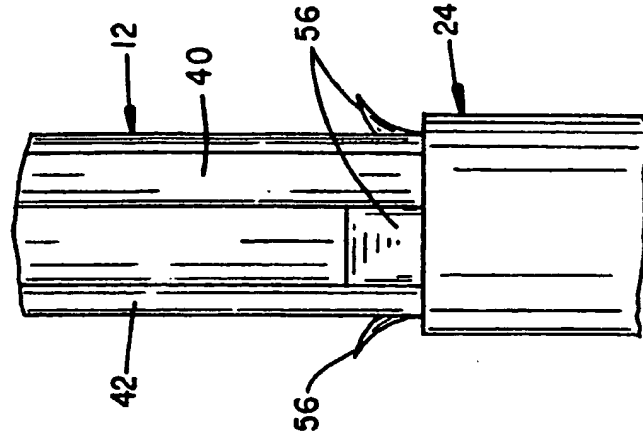


FIG. 11

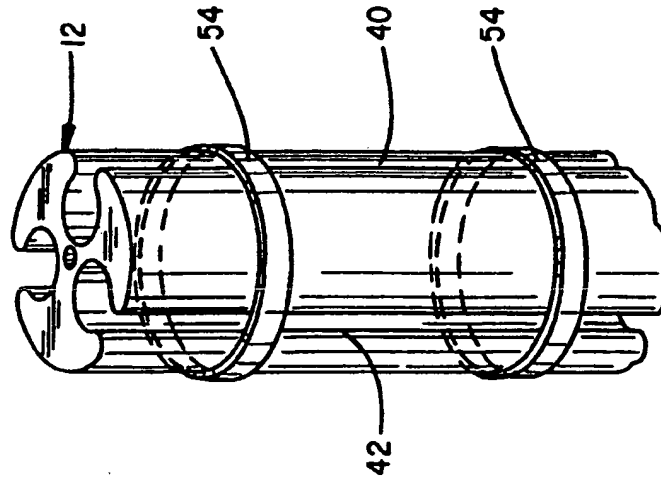


FIG. 10

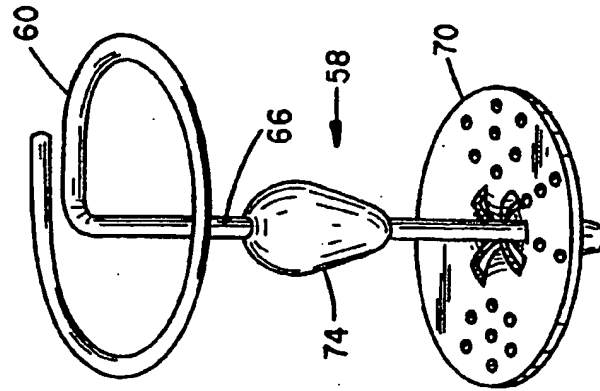


FIG. 14

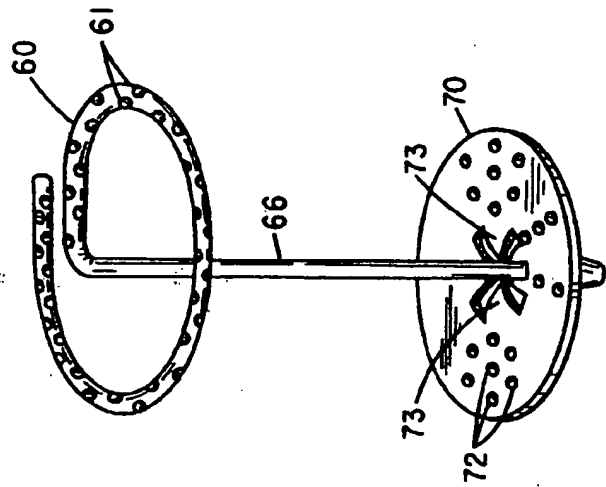


FIG. 13

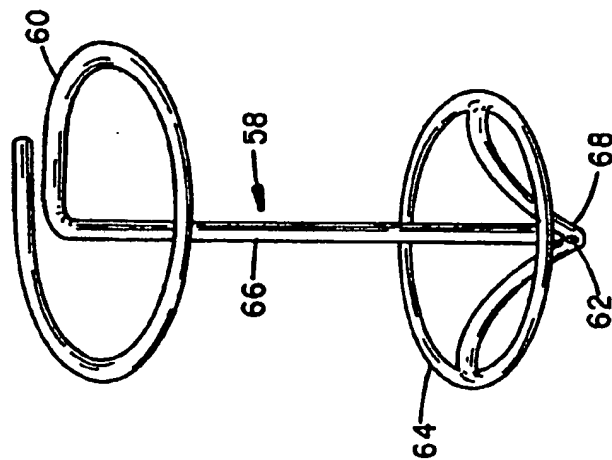


FIG. 12

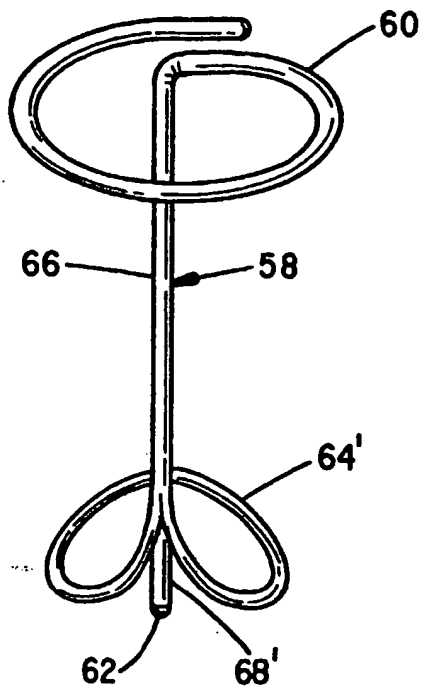


FIG. 12(a)

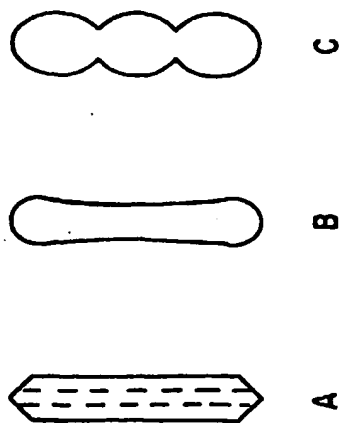


FIG. 15

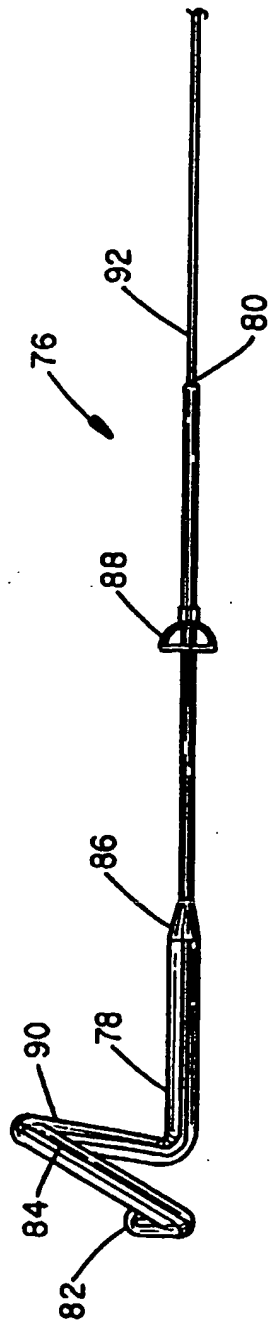


FIG. 16

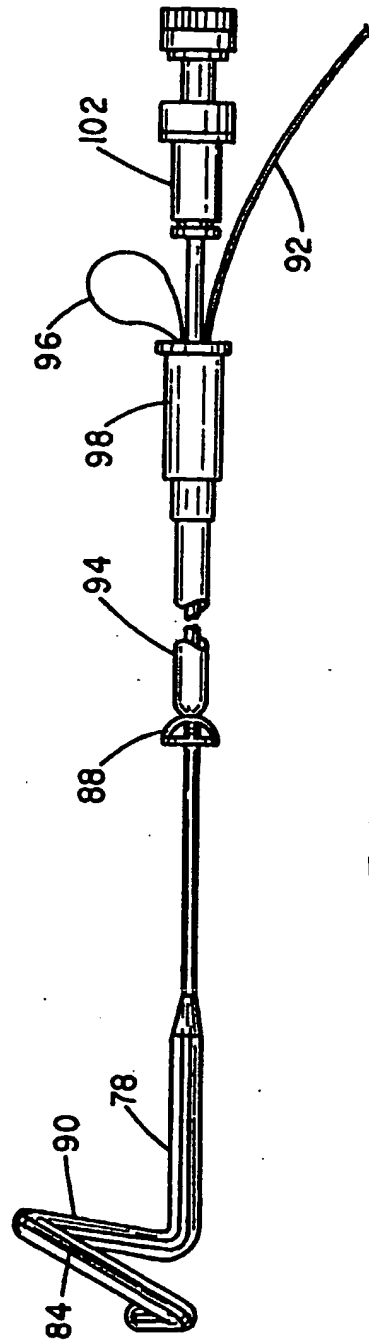
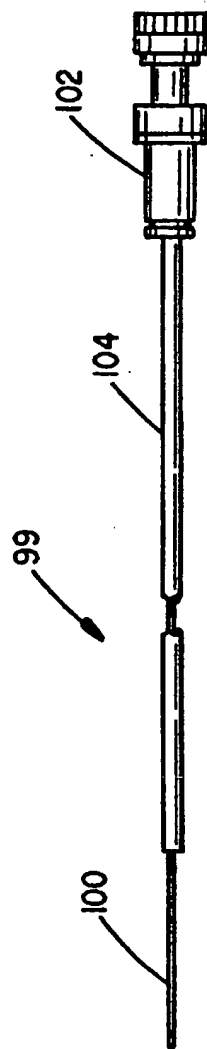
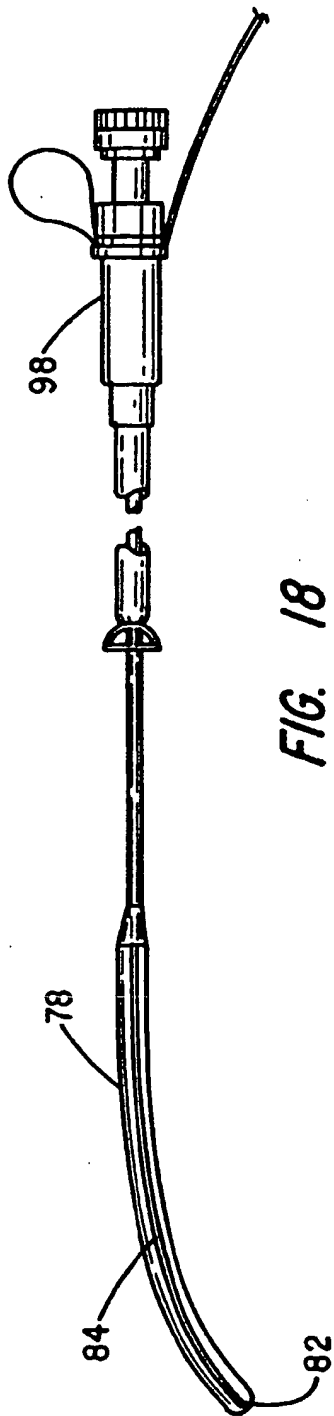


FIG. 17



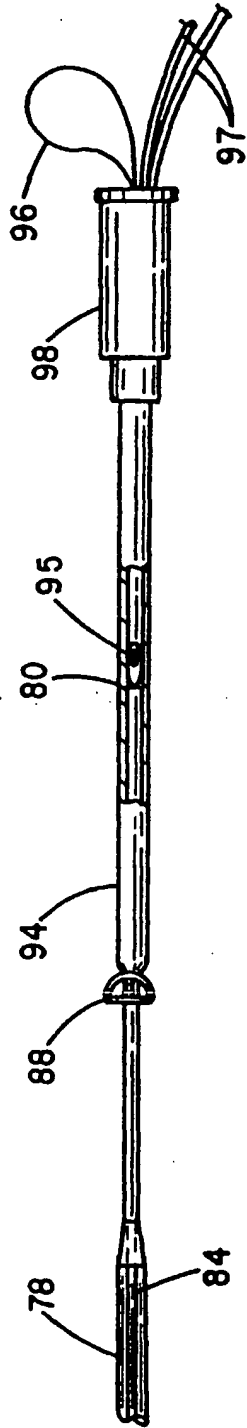


FIG. 20

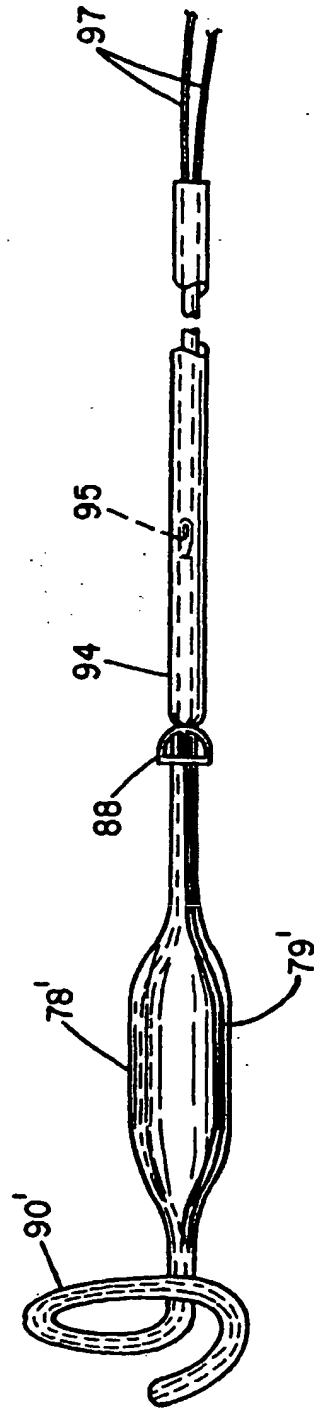


FIG. 21

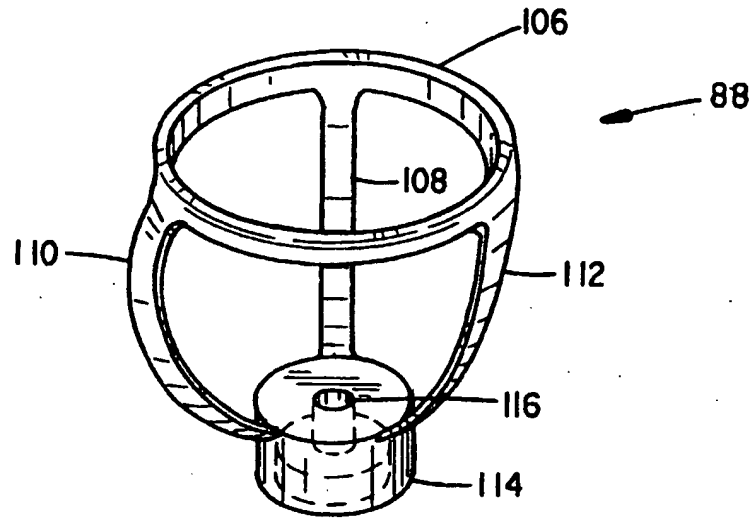


FIG. 22

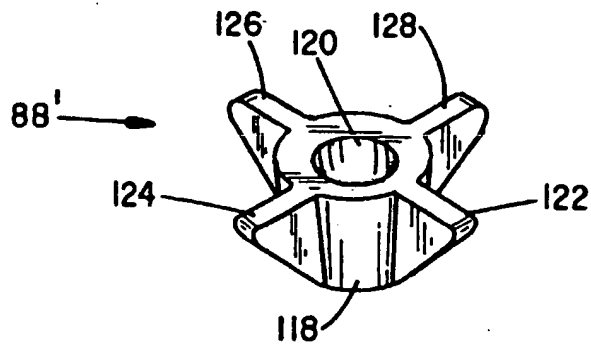


FIG. 23

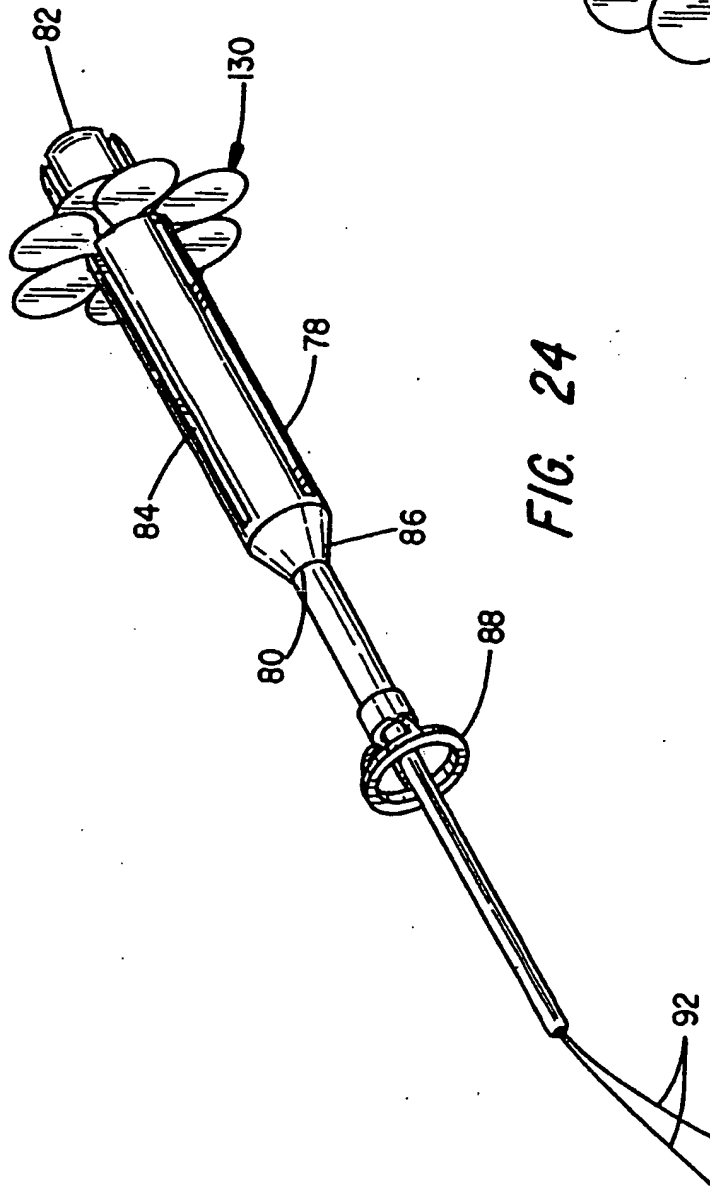


FIG. 24

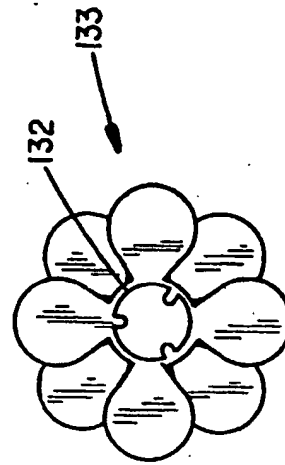


FIG. 25

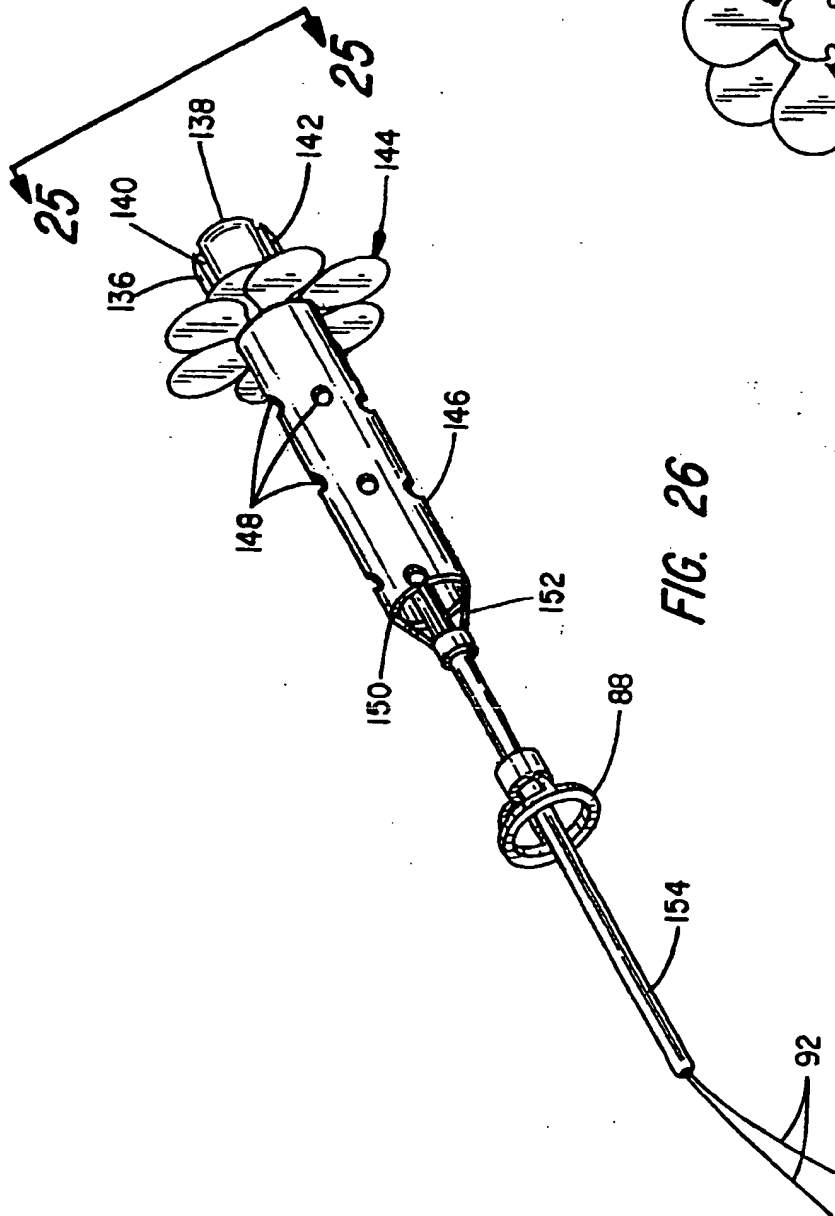


FIG. 26

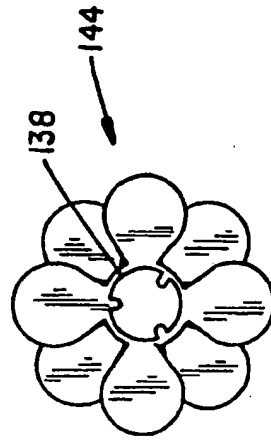


FIG. 27

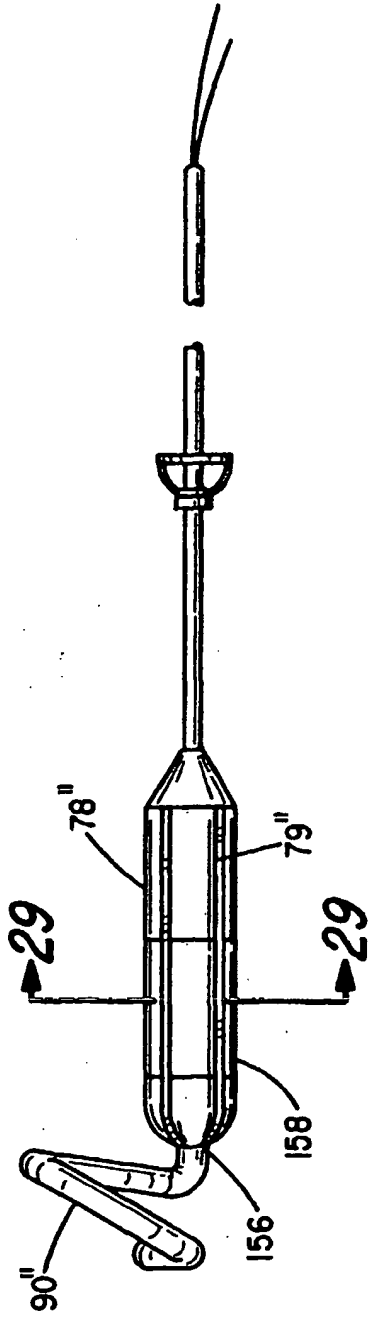


FIG. 28

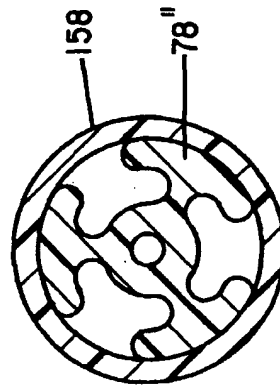


FIG. 29

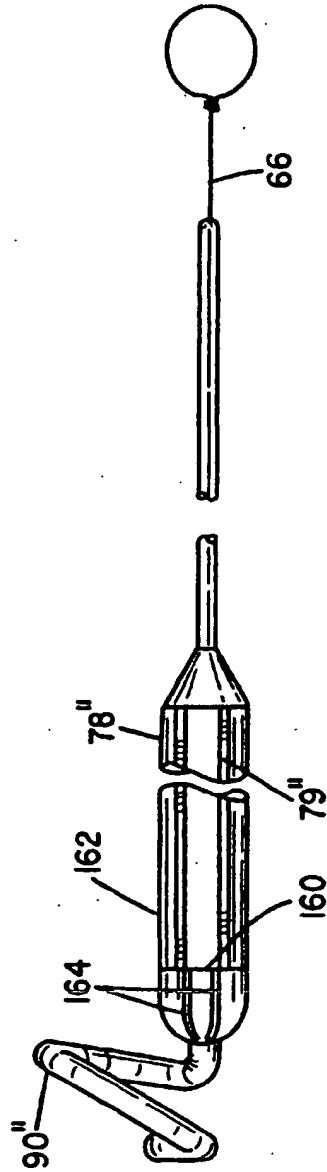


FIG. 30



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